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Comparative growth and yield responses of improved and local varieties of soybean (*Glycine max* (L.) Merrill) in Lafia, Nasarawa State

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Abstract

Soybean is native to Eastern Asia, mainly China, Korea and Japan, from where it spread to Europe and America and other parts of the world in the 18th century. Soybean was first introduced to Africa in the early 19th century, through Southern Africa and is now widespread across the continent. Soybean was first introduced to Nigeria in 1908. Soy bean has many nutritional benefits for man and livestock, as well as other industrial and commercial uses. The present study was aimed at comparing the growth and yield responses of both local and improved varieties of soya beans (Glycine max) in Lafia, Nasarawa State. Three improved varieties, T.G.S1448, T.G.S1449, and C.D.S 1448 and two local varieties of soybean, Mai Farin (MF) and Bakin Hanci (BH) were obtained from the Nasarawa Agricultural Development program (NADP). At 11 WAP, results revealed that TGS1449 recorded the highest plant height (65.00 cm), which differed significantly from TGS1448 (48.00 cm), CDS1448 (50.00 cm), and MF (50.33 cm) ($P \leq 0.05$). The MF variety recorded the highest number of leaves (52.67), which differed significantly from TGS1448 (43.67), and CDS1448 (46.33). Number of flowers was highest in TGS1449 (7.33), which differed significantly from the four other investigated varieties.

Key words: Growth, Yield, Soybean, Improved varieties, Local varieties.

1. Introduction

In the last ten years, the production of legumes has improved drastically (FAOSTAT, 2020). The reason being that it is help in tackling food security, feeding of animals, brings about income, regeneration of soil fertility, nitrogen fixation and help in the control of erosion among others (Kebede, 2020). In recent past, there is massive interest in the use of legume by-products in food production, particularly due to its abundant proteins which could be utilized in the

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production of meat analogs for vegetarian/vegan diets and on a wider scale, in the formulation of functional food for human consumption (Kumar *et al*., 2017).

Soybean (*Glycine max* (L.) Merrill) is a crucial leguminous crop globally. It was first found in East Asia, but it strives very well in the tropical, subtropical and temperate regions of the world, and it is well cultivated during spring as well as the summer season. United States, Brazil, Argentina, China, India, Paraguay and Canada are the major soybean producers in world (Shurtleff and Aoyagi, 2007; IITA, 2009). The nutritional benefits of Soybean are notable for both man and livestock, as well as other industrial and commercial uses. It is used for several purposes but well known and cultivated to be eaten. Due to its richness in protein quality, it is regarded as “the meat that grows on plant”.

Soybean is classified as an oilseed, it contains a huge quantity of all the essential amino acids, minerals and vitamins for human nutrition. It is ranked in the world as the most widely used edible oil, because of its low cholesterol content, has a natural taste and nearly imperceptible odor, this makes it the most preferred vegetable oil for domestic and industrial food processing (Addo-Quaye *et al.,* 1993; Mpepereki *et al*., 2000). Apart from its oil content, soybean contributes immensely to source of human dietary protein with an average of 40% protein, 30% carbohydrate and 20% oil (Adu - Dapaah *et al*., 2004; MoFA and CSIR, 2005).

Almost all margarines, shortenings and salad dressings contain soy oil (Wikipedia, 2009). Furthermore, the major ingredient in biodiesel production is Soy oil, which is fast supplementing fossil fuels (Caminiti *et al.*, 2007). It is a major part of several products such as adhesives, lubricants, plastics, printing inks and health and beauty products (Wikipedia, 2009). The present study investigates the growth and yield responses of local and improved varieties of soya beans (*Glycine max*), as a means of harnessing the comparative advantages of the available varieties for enhanced crop yield and productivity in Lafia, Nasarawa State.

2. Materials and Methods

Study area

The experiment was conducted at the Botanical Garden of the Department of Plant Science and Biotechnology, Federal University of Lafia, located in the Southern Guinea Savanna Region of North-Central Nigeria, on Latitude 8.51667^{0}E, and Longitude 8.4916^{0}N. Lafia L.G.A has a tropical sub-humid climate, with two distinct seasons which are wet season and dry season. The wet season lasts for seven months which is between April and October, while the dry season is between November and March (NIMET, 2005). Rainfall is moderately high in Lafia, ranging from 1200mm to 1600mm (Binbol, 2005). Average maximum and minimum daily temperatures are 35°C and 21°C in rainy season and 37°C and 16°C in dry season respectively (NIMET, 2005)

Source of planting materials

Three improved varieties of soybeans (*Glycine max*), namely T.G.S 1448, T.G.S 1449, C.D.S 1448, and two local varieties, Mai Farin (MF) and Bakin Hanci (BH), used in this study were obtained from Nasarawa Agricultural Development program (NADP), Nasarawa State.

Soil preparation and planting

Garden soil collected from the Botanical Garden of the Federal University of Lafia, was sun-dried to a constant weight, and dispensed in sterile buckets at the rate of 5 kg per bucket. The buckets were then perforated at the bottom to allow the draining of excess water, and arranged at a spacing of 60 cm x 30 cm, as proposed by Okeleye *et al.* (1999). Following soil preparation, soybean seeds were sown at the rate of 4 seeds per bucket, and later thinned to 2 seedlings per bucket. Constant irrigation was done every morning and evening until full maturity and yield was attained.

Experimental design

The experiment was laid out in Randomized Complete Blocked Design (RCBD) with three replications.

Parameters considered

Plant height, number of branches and leaves, leaf area, stem girth, number of flowers per plant, and number of pods per plant were evaluated for the different varieties, at 11 weeks after planting (WAP).

Statistical Analysis

Analysis of variance was performed at 95% level of confidence, using the SPSS software, and differences between means were analyzed using the least significant difference (LSD).

3. Results and Discussion

The results indicated that the studied genotypes differed significantly in some of the evaluated agronomic characters. The TGS1449 variety had the highest plant height (65.00 cm) and number of leaves per plant (52.33) compared to all other varieties tested (Table 1). However, the differences in the plant height of TGS1448, CDS 1448 and Farin Hanci was significant**.** Bakin Hanci and Farin Hanci had the highest number of branches (1.33) each which is significantly different from all the improved varieties having the lowest number of branches (1.00), though, the differences in the numbers of branches of the improved varieties were not significant. Similarly, previous studies by Malik *et al.* (2007) also reported variations in plant height, and number of leaves per plant among different soybean genotypes. Malone *et al*., (2002) also stated that leaves indexes of at least 3.5-4.0 in the reproductive stages are required for maximum potential yield of soybean.

Table1: The Plant height, Number of branches and Leaves of the different varieties

Variety	Plant Height (cm) 11WAS	Number of Branches 11WAS	Number of Leaves 11was
TGS1448	48.00 ± 2.08[a]	1.00 ± 0.00[a]	43.67 ± 0.88[a]
CDS1448	50.00 ± 3.79[a]	1.00 ± 0.00[a]	46.33 ± 1.45[a]
Farin Hanci	50.33 ± 1.76[a]	1.33 ± 0.33[a]	52.67 ± 2.19[b]
Bakin Hanci	61.67 ± 1.67[b]	1.33 ± 0.33[a]	52.33 ± 1.76[b]
TGS1449	65.00 ± 5.29[b]	1.00 ± 0.00[a]	52.33 ± 4.67[b]
LSD	**10.21**	**0.66**	**8.04**

Value represents mean ± standard error

Means followed by same superscripts within same column are not significantly different (P>0.05) or their differences are less than the LSD.

Table 2: The Leaf Area and Stem Girth of the different varieties

Variety	Leaf Area (cm^2) 11WAS	Stem Girth (cm) 11WAS
TGS1448	158.16 ± 22.23[a]	2.07 ± 0.08[a]
CDS1448	159.66 ± 49.41[a]	2.07 ± 0.12[a]
Farin Hanci	139.44 ± 18.86[a]	2.23 ± 0.12[a]
Bakin Hanci	180.21 ± 29.94[a]	2.33 ± 0.12[a]
TGS1449	158.36 ± 20.87[a]	2.43 ± 0.26[a]
LSD	**95.81**	**0.49**

Value represents mean ± standard error

Means followed by same superscripts within same column are not significantly different (P>0.05) or their differences are less than the LSD

Bakin Hanci recorded the highest leaf area (180.21cm^2) which was significantly different from the Farin Hanci with the lowest leaf area (139.44cm^2) (Table 2). However, the differences in the leaf area of CDS1448, TGS1449 and TGS1448 were not significant. TGS1449 showed the highest stem girth (2.43cm) which is significantly different from the TGS1448 and CDS1448 varieties, both having the lowest stem girth (2.07cm). However, the differences in the stem girth of Farin Hanci and Bakin Hanci were not significant**.** Stern and Donald (2011) opined that leaf area index influences crop growth rate, and that dry matter production by a crop also increases as the leaf area index increases, until a maximum value is attained; thereafter as the leaf area index increases further, the rate of dry matter production will decline. This is because; the lowermost leaves become heavily shaded that, photosynthetic contribution becomes less than respiration. Therefore, the Bakin Hanci variety could be most suitable for fodder, compared to the other varieties.

Table 3: The Number of Flowers and Number of Pods of the different varieties

Variety	**Number of flowers 6WAS**	**Number of Pods 8WAS**
TGS1448	1.33 ± 0.33^a	8.67 ± 2.73^a
CDS1448	2.67 ± 1.20^a	13.33 ± 2.96^a
Farin Hanci	4.00 ± 1.73^a	13.67 ± 3.67^a
Bakin Hanci	4.33 ± 1.20^a	12.33 ± 0.33^a
TGS1449	7.33 ± 0.88^b	14.67 ± 4.48^a
LSD	**3.67**	**9.95**

Value represents mean ± standard error

Means followed by same superscripts within same column are not significantly different (p>0.05) or their differences are less than the LSD

TGS1449 showed the highest number of flowers and highest number of pods per plant (7.33, 14.67) respectively which was significantly different from TGS1448 which had the lowest number of flowers and the number of pods per plant (1.33) (8.67) respectively (Table 3). However, the differences in the numbers of flowers and number of pods per plant of CDS1448, Bakin Hanci and Farin Hanci was significant. Pod and seed number are the most important yield components of soybean (Liu *et al.,* 2004). Similarly, Arshad *et al.* (2006) stated that number of pods and seeds are the most important plant traits contributing to improved economic yield in soybean crop, and hence suggested that these traits should be given more importance while selecting superior soybean genotypes. According to Reynolds *et al*. (2012), vegetative, reproductive, and grain-filling phases of any crop are critical developmental stages determined by interactions between genetic and environmental factors and are responsible for adaption and yield generation. Hence, the TGS1449 variety could be considered the variety of choice for enhanced yield of soybean in the studied area.

Plate 1: Research layout at 2WAP

Plate 2: Research layout at 4WAP

Plates 3: Research layout at 6WAP

Plate 4: Research layout at 8WAP

Plate 5: CDS1448 at 11WAP

Plate 6: Research layout at 11WAP

4. Conclusion

The study revealed that the general growth and yield performance attributes of the improved varieties were higher than those of the tested local varieties. Consequently, the TGS1449 variety having the highest and significantly different plant height, number of leaves and flowers, could be considered the variety of choice for enhanced yield and productivity of soybean in the studied area.

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References

Addo-Quaye, A. A., Saah, M. K., Tachie-Menson, C. K. B., Adam, I., Tetteh, J. P., Rockson-Akorly, V. K. and Kitson, J. E. (1993). General Agriculture for Senior Secondary Schools. MOE. 191-194.

Adu-Dapaah, H. K., Asafo-Adjei, B., Owusu-Akyaw, M. and Amoah, S. (2004). Sustainable Soybean Production in Ghana. Paper presented at a Radio program on soybean in Ghana 6 pages.

Arshad, M., Ali, N. and Ghafoor, A. (2006). Character correlation and path coefficient in soybean *Glycine max* (L.) Merrill. *Pakistan Journal of Botany*. **38**(1): 121-130, Binbol N. L. (2005): Climate: in Geographic Perspective on Nasarawa State. Onaivi Printing and publication company Keffi, Nasarawa State

Caminiti, M., Casal, M., Maitiu, O. and Zeru, Y. (2007). Feasibility Study of Biofuel Production in Ghana. Technoserve- Ghana report. 63pp.

FAOSTAT (2020). Food and Agriculture Organization Statistics. Available online: http:// www.fao.org/faostat/en/#home.

IITA, (2009). Soybean overview. Summary. 5pp.

Kebede, E. (2020). Grain legumes production and productivity in Ethiopian smallholder agricultural system, contribution to livelihoods and the way forward. Cogent Food and Agriculture. **6**(1): 1-20.

Kumar, P., Chatli, M.K., Mehta, N., Singh, P., Malav, O.P. and Verma, A.K. (2017). Meat analogues: health promising sustainable meat substitutes. Crit. Rev. Food Sci. Nutr. **57**: 923-932.

Liu, X., Jin, J., Herbert, S. H., Zhang, Q. and Wang, G. (2004). Yield Components, Dry Matter, Leaf Area Index and Leaf Area Duration of Soybean in Northeast China. Chinese Academy of Sciences. Field Crops Research. **93** (1): 85-89.

Malik, M. F., Ashraf, A.M., Qureshi, A.S. and Ghafoor, A. (2007). Assessment of genetic variability, correlation and path analyses for yield and its components in soybean. *Pakistan Journal of Botany*. **39**(2): 405-413.

Malone, S., Herbert Jr, D. A. and Holshouser, D.L. (2002). Relationship between Leaf Area Index and Yield in Soybean Planting Systems. *Journal of Economic Entomology*. **23**(2):34-39.

MoFA and CSIR, (2005). Soybean Production Guide. Food crops development project. Ghana's Ministry of Food and Agriculture. 38pp.

Mpepereki, S., Javaheri, F. and Davis, P. (2000). Soybean and Sustainable Agriculture: Promiscuous Soybean in Southern Africa. *Field Crops Res* **63**:137 – 149.

Nigerian Meteorological Agency (NIMET) (2005): in Geographic Perspective on Nasarawa State. Onaivi Printing and publication company Keffi, Nasarawa State.

Okeleye, K., Ariyo, O.J., Olowe, U.I. (1999). Evaluation early and medium duration cowpea *(Vigna unguiculata (*L.*)* Walp*)* cultivars for agronomic traits and grain yield. *Nigeria Agriculture Journal.* **30**:1-11

Reynolds, M.P., Pask, A.J.D. and Mullan, D.M. (eds.) (2012). Physiological Breeding, I: Interdisciplinary Approaches to Improve Crop Adaptation. Mexico, D.F.: CIMMYT.

Shurtleff, W. and Aoyagi, A. (2007). The Soybean Plant: Botany, Nomenclature, Taxonomy, Domestication and Dissemination. Soy info Center, California. 40pp.

Stern, W.R. and Donald, C.M. (2011). Relationship of Radiation Leaf Area Index and Crop

Wikipedia, (2009). Wikipedia Foundation Inc. U.S.A. registered. 501(c) (3) 32 Pages.